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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/683,937 | 10/10/2003 | Yihwan Kim | APPM/8538/TSG/EPI/RKK | 2191 |

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| EXAMINER | |
|---|---|
| TRINH, MICHAEL MANH | |
| **ART UNIT** | **PAPER NUMBER** |
| 2822 | |

DATE MAILED: 03/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

H:A

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/683,937 | KIM ET AL. | |
| | Examiner | Art Unit | |
| | Michael Trinh | 2822 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address.--*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *27 February 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-27,42 and 56-67* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27,42 and 56-67* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

**DETAILED ACTION**

*** This office action is in response to Applicant's Amendment and RCE filed February 27, 2006. Claims 1-27,42,56-67 are pending, in which claims 56-67 have been newly added.

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

***Claim Rejections - 35 USC § 103***

1. Claims 1-11,12-24,25-27,42,56-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oda et al (2001/0045604) taken with Steele et al (5,273,930), Murthy et al (6,235,568), Hashimoto (2002/0142557).

Oda teaches a method of depositing a silicon germanium film on a substrate comprising: providing the substrate within a process chamber; heating the substrate to a temperature in a range from about 500 to about 900 degree C (paragraph 100, lines 25-50, re claim 67 also) ; exposing the substrate to a first deposition gas comprising $SiH_4$, $GeH_4$, HCl, a carrier gas of hydrogen and at least one dopant gas (paragraph 100, lines 7-25); and epitaxially and selectively depositing a first silicon germanium material on the substrate, wherein the silicon germanium material is deposited with a boron concentration in a range from about $1x10^{20}$ atoms/$cm^3$ (paragraph 0103; paragraphs 0136 and 0153), wherein Oda also disclosed "the upper limit may be $1x10^{20}$ $cm^{-3}$ at which the diffusion of the dopant is remarkable"; in other words, Oda already recognized and thus disclosed that diffusion of the dopant is remarkable by having the dopant concentration greater than about $1x10^{20}$ $cm^{-3}$; and exposing the substrate to a second deposition gas, wherein the gas comprises dichlorosilane (lines 5-25 of paragraph 100) and a germanium source to selectively and epitaxially deposit a second silicon germanium material on the first material (Figs 13,10,11,5-6; paragraphs 0123,0116,0103). Re claims 2,45,47,48,51,52,60,63,64, wherein the at least one dopant gas is a boron containing compound selected from the group consisting of diborane ($B_2H_6$ in paragraph 0100). Re claims 3,46,58,59,63 wherein the silicon germanium material is deposited with a boron concentration in a range from about $1x10^{20}$ atoms/$cm^3$ (paragraph 0103; and paragraphs 0136 and 0153), wherein Oda disclosed "the upper limit may be $1x10^{20}$ $cm^{-3}$ at which the diffusion of the dopant is remarkable". Re claims 4,45,51,58-59, wherein the at least one dopant gas includes a phosphorus containing compound of phosphine (PH3 I paragraph 0100). Re claim 5, wherein the carrier gas is hydrogen

(paragraph 0100, lines 25-25). Re claim 6, wherein the deposition gas further comprises a member selected from the group of consisting of a carbon source, $Cl_2SiH_2$ (paragraph 0100, lines 7-45). Re claim 7, wherein the temperature is of 600° C or higher to about 900°C, wherein a temperature of 750°C is used, wherein the process chamber is at a pressure of 0.1 Pa (paragraph 0101; page 7, right column, lines 3-11, wherein 0.1 Pa is in the claimed range from about 0.1 Torr to about 200 torr). Re claims 8,54,66, wherein the silicon germanium film is grown to a thickness in a range from about 1nm to 50nm (paragraph 0103, page 7, right column). Re claim 9, wherein the silicon germanium film is deposited within a device used for CMOS, Bipolar or BiCMOS application (paragraphs 0003, 0010). Re claim 10, wherein a fabrication step is selected from the group consisting of contact plug, source/drain extension, elevated source/drain 13,14,134,135 and bipolar transistor with buffer layer 8 (Fig 3D; paragraphs 0089-0110,0103). Re claim 12, wherein a silicon-containing film 104 is deposited to the substrate before the silicon germanium film 105 (Fig 45; paragraph 0006; Fig 46; paragraph 0009; Figs 3e-3d; 4-6; paragraphs 0101-0104). Re claim 13, wherein the silicon-containing film is deposited from a process gas comprising $Cl_2SiH_2$ (paragraphs 0100,0103). Re claim 14, as already similarly applied in claims 1 and 3, with a dopant concentration of about $1x10^{20}$ atoms/$cm^3$ (paragraph 0103). Re claim 15,65, wherein the germanium source is selected from the group consisting of $GeH_4$ (paragraph 0100). Re claim 16, wherein the carrier gas is hydrogen (paragraph 0100, lines 25-25). Re claims 17,55, wherein the temperature is of 600° C or higher to about 900°C, wherein a temperature of 750°C is used. Re claim 18, wherein the etchant source is selected from the group consisting of HCl, and $Cl_2$ (paragraph 0100). Re claim 19, wherein the at least one dopant gas is a boron containing compound selected from the group consisting of diborane ($B_2H_6$ in paragraph 0100). Re claim 20, wherein the at least one dopant gas includes a phosphorus containing compound of phosphine (PH3 I paragraph 0100). Re claim 21, wherein the deposition gas further comprises a member selected from the group of consisting of a carbon source, $Cl_2SiH_2$ (paragraph 0100, lines 7-45). Re claim 22, wherein the silicon germanium film is grown to a thickness in a range from about 1nm to 50nm (paragraph 0103, page 7, right column). Re claim 23, wherein the silicon germanium film is deposited within a device used for CMOS, Bipolar or BiCMOS application (paragraphs 0003, 0010). Re claim 24, wherein a fabrication step is selected from the group consisting of contact plug, source/drain

extension, elevated source/drain 13,14,134,135 and bipolar transistor with buffer layer 8 (Fig 3D; paragraphs 0089-0110,0103). Re claim 26, wherein a silicon-containing film 104 is deposited to the substrate before the silicon germanium film 105 (Fig 45; paragraph 0006; Fig 46; paragraph 0009; Figs 3e-3d; 4-6; paragraphs 0101-0104). Re claim 27, wherein the silicon-containing film is deposited from a process gas comprising $Cl_2SiH_2$ (paragraphs 0100,0103). Oda already teaches to (at lines 5-10) using either silane ($SiH_4$) or dichlorosilane ($Cl_2SiH_2$) as a silicon source gas for depositing the silicon germanium material on the substrate.

Oda teaches a concentration of $1x10^{20}$ atoms/$cm^3$ or less; while claims 56,1,14, and 42 recite about $2.5x10^{21}$ atoms/$cm^3$. Re further claim 25,1, Oda lacks having carbon source, and using $Cl_2SiH_2$ to deposit a second silicon germanium film.

However, Murthy teaches (at col 11, lines 60-65; and line 49 through col 12) depositing a doped silicon germanium material having a dopant concentration of greater than about $5x10^{20}$ atoms/$cm^3$ (col 3, lines 42-47; col 5, lines 30-40; col 11, lines 8-15; col 7, line 45 through col 8, line 67), wherein a dopant concentration of about $5x10^{21}$ atoms/$cm^3$ is mentioned at column 11, lines 60-65, wherein employing a dopant concentration of about $1x10^{20}$ - $2.5 x10^{21}$ atoms/$cm^3$ is mentioned at col 5, lines 10-40); wherein the doped silicon germanium material is deposited by using a silicon source gas, a germanium source gas, a hydrochloride, and boron dopant source gas). Steele teaches (at col 3, line 50 through col 4; cols 5-6) depositing a seed film to a first thickness by dichlorosilane ($Cl_2SiH_2$) to deposit a second silicon germanium film to a second thickness on the seed film. Hashimoto teaches (at Figs 12-13; paragraphs 0078-0083) selectively and epitaxially depositing a layer 19 of either silicon germanium (SiGe) by using silane or dichlorosilane or a silicon germanium carbon having a carbon source (paragraph 0083)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form silicon germanium materials of Oda by using silicon source gases of silane ($SiH_4$) and dichlorosilane ($Cl_2SiH_2$) to deposit a second silicon germanium film to a second thickness on the seed film as taught by Steele and Hashimoto, wherein selectively and epitaxially depositing a silicon germanium (SiGe) layer or a silicon germanium carbon layer (SiGeC) having a carbon source is also taught by Hashimoto. This is because of the desirability to improve performance of the product films, and to form a silicon germanium film or silicon germanium carbon having lower bandgap energy. The subject matter as a whole would have

been obvious to one or ordinary skill in the art at the time the invention was made to select the portion of the prior art's range of dopant concentration of greater than about $5x10^{20}$ atoms/$cm^3$ and to about $5x10^{21}$ atoms/$cm^3$, as taught by Murthy, wherein employing a dopant concentration of about $1x10^{20}$ - 2.5 $x10^{21}$ atoms/$cm^3$ is also taught by Murthy, which is range of applicant's claims, because it has been held to be obvious to select a value in a known range by optimization for the best results, and would be an unpatentable modification, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 104 USPQ 233,255 (CCPA 1955); *In re Waite* 77 USPQ 586 (CCPA 1948); *In Re Swanson* 56 USPQ 372 (CCPA 1942); *In Re Sola* 25 USPQ 433 (CCPA 1935); and *In Re Dreyfus* 24 USPQ 52 (CCPA 1934).

***Response to Amendment***

2. Applicant's remarks submitted January 30, 2005 have been fully considered but they are moot in view of new ground(s) of rejection.

As described above, Murthy obviously teaches depositing a doped silicon germanium material having a dopant concentration of greater than about $5x10^{20}$ atoms/$cm^3$, wherein a dopant concentration of about $5x10^{21}$ atoms/$cm^3$ is mentioned at column 11, lines 60-65, wherein employing a dopant concentration of about $1x10^{20}$ - 2.5 $x10^{21}$ atoms/$cm^3$ is mentioned at col 5, lines 10-40).

**********

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 9:00 Am to 5:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The central fax phone number is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Oacs-16

Michael Trinh
Primary Examiner